FACTSHEET
AGRICULTURAL ENGINEERING
ANIMAL SCIENCE
ORDER NO. 05-025
MARCH 2005
AGDEX 743/530
Ontario Ministry of Agriculture, Food and Rural Affairs

Nutrient Management Act, 2002

MANURE MANAGEMENT FOR FARMS PRODUCING MORE MANURE THAN THEIR CROPS NEED

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(Replaces OMAFRA Factsheet *Options for Farms that Produce More Manure than their Landbase can Handle*, Order No. 96-105, Printed April 2006)

INTRODUCTION

Manure is an excellent source of plant nutrients, however, applying too much of it to an area of land can increase the risk of environmental concerns. This Factsheet outlines how to determine landbase needs and discusses options for farms to manage the manure if enough landbase is not available.

DETERMINING YOUR LANDBASE NEEDS

A number of factors must be considered in order to determine the landbase capacity of your Farm Unit to safely receive manure. The OMAFRA computer software program NMAN or corresponding workbook (OMAFRA Publication 818) are tools that help farmers determine values for each of the following factors.

Legislative Note: A Farm Unit is the land and associated facilities of an agricultural operation. For more information on this topic or any other Legislative Note in this Factsheet, see the More Info boxes at end of the document.

Factor 1: Nutrient Value of Manure to be Applied

The nutrient value of manure varies greatly from one animal type to the next (see Table 1). The best way to determine the nutrient value of your manure is to have it analyzed by an accredited lab for nitrogen (N), phosphorus (P), potassium (K) and dry matter content. Take liquid manure samples from an agitated tank to obtain an accurate estimate of nutrients. For a representative solid manure sample, take samples from several locations of a pile. Average manure nutrient concentrations for a range of livestock types are found in the OMAFRA computer software program NMAN.

TABLE 1. Nutrient Unit (NU*) Designations for a Variety of Different Animal Types

Type of Livestock	# animals per NU
Large frame dairy cow	0.7
Beef feeders	3
Swine- finishing pigs	6
Lamb feeders	20
Chickens- layer pullets	500

* A NU is equal to the amount of manure needed to give the fertilizer replacement value of the lower of 43 kg of N or 55 kg of P. For example, it takes the manure from 3 beef feeders to get the equivalent of 1 NU.

Factor 2: Planned Crop Rotation

The nutrient requirements of crops vary from one crop to another. What are the nutrient requirements of your current crop rotation? To what extent can your manure be applied to meet these requirements?

Factor 3: Current Soil Nutrient Levels, Soil Type, and Topography of the Landbase

If soil nutrient levels are already high, nutrient additions from manure could be limited. The best way to determine the nutrient levels in your soil is to submit a soil sample for analysis. Soil type and topography can also limit the landbase capacity for manure due to the higher risk of occurrence of contaminated runoff from soil with low soil infiltration and steep slopes.

Factor 4: Proximity to watercourses or other environmentally sensitive areas

In order to reduce the risk of surface or well water contamination setbacks for manure application are used. These setbacks should be considered when calculating how much land remains for manure application.

Setbacks in Ontario

- 330 ft. (100 m) from municipal wells
- 50 ft. (15 m) from drilled wells or 100 ft. (30 m) from any other well
- 10 ft. (3 m) to 200 ft. (60 m) from the bank of surface water). This setback depends on a number of factors such as the incorporation method used, the slope near the watercourse and the P Index value (see OMAFRA Factsheet, *Determining the Phosphorus Index for a Field*, Order No. 05-067)

Legislative Note: The Nutrient Management Regulation specifies required setbacks for regulated farm units. The setbacks resulting from the P Index are not regulated but are still a recommended practice.

In addition a 10 ft. (3 m) buffer is required along all watercourses in fields where nutrients are applied and a nutrient management plan is required by the Nutrient Management Regulation.(except on organic soils) (*Figure 1*).

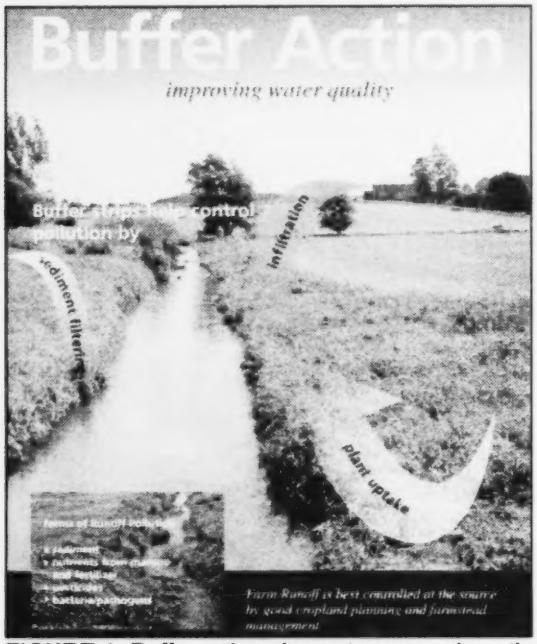

FIGURE 1. Buffer strips along streams reduce the risk of water pollution from nutrients.

OPTIONS FOR FARMS THAT PRODUCE MORE MANURE THAN THEIR LANDBASE CAN HANDLE

If you determine you have more manure nutrients than your landbase can handle, consider the following options:

1. Increase the size of the landbase
2. Reduce the amount of manure nutrients to handle
3. Apply more manure to the same landbase
4. Move manure off-site
5. Adopt innovative treatments of manure

OPTION 1. Increase the Size of the Landbase in your Farm Unit

There is enough cropland in Ontario to handle all the nutrients from manure in the foreseeable future. The challenge is in obtaining a localized landbase for the farm's manure since transporting manure to remote sites can be costly (see end of this section for more on landbase accessibility).

There are five approaches to increase the size of the landbase in your Farm Unit.

1. Purchase More Land on the Same Property Deed as the Livestock Facility

Incorporating an additional landbase onto the same deed gives greater assurance that a proper landbase remains with the barns that produce the manure. This process is accomplished by purchasing an adjoining landbase. After purchase by the same owner, the properties are then joined on the same deed.

As livestock operations become larger, obtaining enough adjoining properties will be difficult. It is expected that many operations will gradually expand their landbase as properties surrounding the livestock operation become available.

FIGURE 2. Using a drag hose for liquid manure application can minimize risk of soil compaction.

2. Purchase More Land on a Different Deed

Owned land on a different deed gives the operation full control of use of the landbase. However, there is a concern that the additional property could be sold in the future possibly leaving the livestock facility without an adequate landbase.

This land should be located close to the livestock facility to lower the cost of manure handling. The accessibility of this land base for spreaders or direct flow manure application systems* (e.g. drag hose systems, see *Figure 2*) should be considered.

***Legislative Note**: The use of high trajectory irrigation guns as a direct flow manure application method is prohibited by the NMA regulation when the manure being applied exceeds 1% Dry Matter.

3. Rent Land on a Long-Term Lease

Tillable land rented by the owner of the livestock operation on a long-term lease is generally preferred over a manure application agreement (see section below). The renter has control of the timing and scheduling of crops to facilitate the application of manure. This is especially important if the livestock operation has limited manure storage capacity.

Legislative Note: For NMA regulation purposes rented or leased land is treated the same as owned land, i.e. it is under control by the operator.

4. Use a Manure Application Agreement

A Manure Application Agreement is another way to handle manure without land purchase. Though the land listed in an Application Agreement would not become a registered part of a farmer's deeded property, the farmer would list the land on his Farm Unit Declaration Form when completing a Nutrient Management Strategy (NMS).

Legislative Note: Manure Application Agreement, is not a required agreement under the NMA regulation but it is an option for the farmer.

The longevity of the Agreement can range from 1–5 years. The landowner will be more likely to renew their Agreement in the long term if they see that the land receives benefit from the manure. If the manure is unevenly applied or if damage occurs during application, then the landowner may not gain any benefit and consequently may refuse to continue with the agreement. Proper nutrient testing, development of a NMP and uniform, non-compacting application are keys to maintaining mutual benefit.

5. Rent Land on a Short-Term Lease

A short-term lease can be considered if the livestock operation is in an area where land is regularly available for rent. Then, if one lease is lost, another lease can be picked up. Conversely, if land is rarely available for rent, expansion based on a short-term lease should not be considered.

Legislative Note: For a regulated farm unit, a nutrient management strategy must be redone at least every 5 years. However, a manure application agreement or rental agreement can be for as little as 1 year. It is expected that the operator will continue to renew this agreement over the 5-year span of the strategy. If the agreement is not renewed, it is recommended that the operator prepare a new Nutrient Management Strategy (NMS) if the loss of land means that the amount of manure being generated exceeds the amount that the NMS can accommodate.

Landbase Accessibility for Manure Application

In all of the above 5 approaches, the accessibility of manure-application equipment to the properties must be considered due to the large volumes of manure that must be handled. For example, at a typical rate of 5,000 imperial gallons of manure per acre (47 m^3/ha), 2,500 tons of manure would be applied to a 100-acre farm (approximately 6 times the weight of dry corn you would harvest from the same acreage). (See *Figure 3*)

FIGURE 3 Compaction Issues should be considered when moving/applying manure.

Transporting 2,500 tons of liquid manure via a tractor trailer to a remote site (over 3 km (2 miles) could become expensive. The actual transportation costs could be affected by a number of factors including amount of manure to be transported, distance to remote site, access to transportation equipment or road configuration, i.e. hills, drive through towns/hamlets, crossing major highways, etc. For example, applying manure to a remote site rather than a local one could add an additional cost of 1 cent per gallon of applied manure because of added transportation costs. At an application rate of 5,000 gal/ac (47 m^3/ha), this would mean an additional cost of $50/ac ($124/ha).

If manure spreaders are to be used, consider road travel and crossings necessary to access a remote field. Turns on busy highways are very dangerous since the large tanker often reduces or blocks visibility. Repeated turns by a loaded multi-axle tanker on hot pavement can cause extensive damage to the road. Safety concerns and extensive equipment damage could also occur to farm equipment if the size of the manure tanker is too big for the size of the tractor pulling it.

Direct flow liquid manure uses a pipeline to move the manure to the field. In many situations at least one road, stream or private property crossing will be involved to reach a field. Proper permission must be obtained for any crossing or road access. For a livestock farm, consider the

installation of a permanent underground pipeline to remote fields. Although more expensive initially, it allows quick, long-term access.

OPTION 2. Reduce the Amount of Manure Nutrients to Handle

Reduction of nutrients in the manure will cause a decrease in the amount of land required to spread manure from the farmstead (unless liquid loading is the limiting factor). There are 3 approaches discussed below.

1. Improve Efficiency of Nutrient Conversion from Feed to Product

Most steps that improve the productivity of a livestock operation (such as genetic improvements or feed ration balancing) will improve nutrient conversion. However, in some cases there is a trade off between conversion efficiency and productivity. An operator must balance all factors in making a decision.

Specialized feed additives* designed to make certain nutrients in feed more usable to the animal are coming on the market. If effective, these products should improve nutrient conversion and reduce nutrient levels in manure. For example, the additive phytase has been found to reduce phosphorus in swine manure by 25%–50%. (**Note:* All feed additives have to be approved by Agriculture and Agri-Food Canada before they can become available for commercial use.)

Feeding animals a ration that is finely tuned to their nutritional needs can also reduce animal manure nutrient output, as can reducing the amount of feed spillage. Feed spillage can be reduced by using high quality feeds, spill resistant feeders, good management and by the recycling of refused feed to other animals.

2. Decrease Livestock Production

If you lower the livestock production on the farm you will decrease manure production. If you are already operating a livestock farm, this approach is likely not practical; consider other approaches. However, if you are planning a new or expanded operation, a Nutrient Management Plan should be completed prior to construction. This plan will determine the amount of manure that must be handled and identify the size of landbase required to safely apply it. If an appropriate landbase cannot be obtained, then downsizing or relocation of the facility could be considered.

3. Remove Nutrients from Manure

Some treatments of manure will reduce the amount of a particular nutrient to handle. For example, during a composting process, nitrogen may be lost to the air and will not have to be applied to the landbase. However, one has to consider the environmental problems being created as well as the economic losses. For example, when composting, the "lost" nitrogen will be ammonia, which can cause an odour concern and result in loss of a nitrogen source for crop fertilizer.

OPTION 3. Apply More Manure to the Same Landbase

Increasing the application rate of manure without causing environmental problems or crop yield reductions is another approach to deal with excessive manure nutrients. Listed are 5 approaches available to increase manure application rates.

1. Reduce Commercial Fertilizer Use

By reducing commercial fertilizer applications, you may be able to apply a higher rate of manure to a field. A Nutrient Management Plan should be developed to properly match the nutrients in both the manure and fertilizer with the crop nutrient requirements. This plan should include manure and soil nutrient tests. OMAFRA's NMAN software allows you to match these requirements and test various "what if" scenarios.

Legislative Note: A Nutrient Management Plan must be developed if the manure is to be applied on a regulated farm unit that generates 300 nutrient units or more or if any part of the farm unit is less than 100 m from a municipal well.

When using manure as a major source of nutrients, it is very important to apply the manure evenly at the correct rates. Accurate, properly calibrated application equipment is necessary. New technology is becoming available to improve calibration and provide uniform application of manure (see *Figure 4*).

2. Reduce Use of Organic Nutrient Sources

Other nutrient sources such as ploughed-down red clover or sewage sludge applications can provide a significant addition of nitrogen to a field. In most cases, the operation will benefit. However, if the full landbase is required to utilize nitrogen in the manure, then the use of these organic nutrient sources should be reconsidered.

3. Increase Crop Uptake of Nutrients

Increasing crop nutrient requirements will proportionally increase the amount of nutrients that can be applied to the field. Examples of increasing crop uptake are to:

- change to a crop or crop rotation that removes more nutrients from fields (see Table 2)
- produce higher yielding crops
- switch to some legume-based crops such as alfalfa, which use high levels of all nutrients (an alfalfa crop will use soil-based nitrogen if available rather than producing its own).

The NMAN computer software program (or associated workbook) can help to estimate multiple "what if" scenarios.

FIGURE 4. Example of a flow meter sensor mounted on a manure tanker. Talk to your local dealer for available products.

4. Allow Build-up of Nutrients in the Soil

Phosphate and potassium, will build up in the soil profile if applied above the crop's needs. If initial soil levels are low, then some increase is preferable, provided that separation distances from surface water are maintained. However, there will be a limit on how long a build-up can continue before environmental problems or crop growth restrictions occur. A nutrient management plan completed using the NMAN software (or associated workbook) will identify situations were it is recommended that P not be applied over crop removal or not be applied at all.

Legislative Note: If P levels get too high, the phosphorous limit in the NMA regulation may restrict the addition of P beyond crop-removal levels, or in some cases, restrict the addition of P nutrients altogether.

Since a livestock operation is a long-term venture, most landbase calculations should not be based on significant nutrient build-ups in the soil. One exception is when a remote landbase is to be used for a limited number of years.

TABLE 2. Nutrient Removal Rates of Common Field Crops[1]

Crop	Yield*	Nutrient Removal (lb/ac)		
		N	P	K
Corn Silage	20	229	102	213
Alfalfa Hay	2.2	138	29	132
Soybeans	45	175	38	63
Grain Corn	148	122	62	43
Winter Wheat	76	91	45	27

(NMAN 2003)

[1] Corn silage has the highest total nutrient removal rate, followed by alfalfa, soybeans, grain corn, and winter wheat.

* All yields are in bu/ac except corn silage and grass hay which are in ton/ac

5. Improve the Absorbing Ability of the Soil

The ability of soil to absorb manure may be limited by wet compacted soils and/or steep slopes. The absorbing ability of the soil can be improved by pre-cultivation or by improving the soil structure.

Alternatively, higher rate of manure application may be achieved by completing multiple application passes with each pass at a very low rate.

Contamination of drainage tile water via cracks to the soil surface is another concern. Use of reduced rates, tillage prior to manure application or monitoring of tiles may be necessary in fields prone to this problem.

OPTION 4. Move Manure Off-Site

In some cases, transfer of manure to an off-site location may be preferable.

1. Manure Broker Agreements

In some areas of Ontario, a manure broker (also called a manure removal contractor) will take the manure from the barn, store it and transfer it to another client. This approach is frequently used for handling solid manure (such as broiler manure) where there is a substantial demand for the manure as a source of organic matter for growing crops.

Legislative Note: When a broker is used as a part of a NMS, the appropriate Broker Agreements must be included. These agreements demonstrate an understanding between the farmer and the broker that once the broker takes the manure, it will be managed responsibly under a NMS/P.

2. Manure Transfer Agreement

A manure transfer agreement is used to transfer manure to another farm that is not part of the same farm unit.

Legislative Note: Two types of agreements are used. If the receiving farm is another regulated farm unit, a Nutrient Transfer Agreement is completed. This transferred manure must be included in the receiving farm's NMS. If the receiving farm *is not* a regulated farm unit, information must be included in the generator's NMS to indicate the receiving farm's area, type and livestock information.

OPTION 5. Adopt Innovative Treatments of Manure

The main goal of manure treatment is to produce a product that is easier to handle and less objectionable to users and their neighbours (therefore increasing or maintaining the landbase available to spread). Following are three ways to treat manure:

1. Manure Separation

Separation produces a "solid" component out of liquid manure. This "solid" material is easy to transport and in more demand by potential customers. The remaining liquid component is typically spread at the livestock operation. In some cases, separation can be completed by just continuously draining the liquids from the manure. Conversely, more complex systems such as a screw separator can be used to extrude a solid material from liquid manure (*Figure 5*). It is expected that 20% of the total nutrients from a free-stall barn can be "solidified" this way.

Another approach to produce a solid material is to change the manure handling and storage system to produce a solid form of manure. An example of this is in layer barns where belt manure handling systems are used along with water conservation to produce a solid form of manure. Research projects indicate that the same technology can be used in hog finishing barns where a sloped belt under the slats immediately separates the solids from the liquids.

2. Manure Composting

Composting solid manure can reduce the total volume by 30% – 50% and decrease the odour level. This results in less volume of product to be handled and a possible off-farm use by horticultural or residential users.

3. Increase the Nutrient Concentration in Liquid Manure

Reducing the water content in liquid manure will concentrate the nutrients in manure making it easier to justify the cost of transferring the nutrients to remote fields. Practices such as keeping roof water out of the storage, covering the storage or installing water drinkers with less water loss can often reduce the volume of waste to be handled (for example, adding wet/dry feeders to swine finishing barns can reduce waste to be handled by at least 20%).

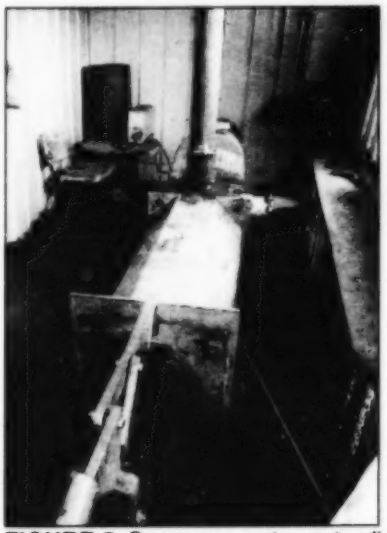

FIGURE 5. Screw separator extruding a solid material from liquid manure.

4. Anaerobic Digesters

A digester treats manure in an oxygen-free environment. Biogas is produced as part of the process that is used to heat the digester with surplus available to produce renewable heat and electrical energy. While it does not reduce volume or nutrient content, it causes a substantial decrease in odour and pathogen levels in the effluent

CONCLUSION

Although there are many options to reduce landbase requirements of manure, proper planning should be completed before the time of construction or expansion of a livestock facility to ensure that adequate landbase is available. On farms where the landbase needs are only *just* met, the farmer should have a comprehensive contingency plan to safely handle any increases in manure volume or decreases in available landbase.

RELATED OMAFRA FACTSHEETS

Manure Agreements with Brokers and Neighbours, Order No.04-061

Farm Units: Determining What Operations and Land to Include, Order No. 06-029

Odour Control on Livestock and Poultry Farms, Order No. 03-111

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APPENDIX 1 MANURE APPLICATION AGREEMENT — SAMPLE

An application agreement may be completed by operations required to have a Nutrient Management Plan and/or Nutrient Management Strategy as defined by Ontario Regulation 267/03, where nutrients are applied to land that is not owned or rented by the generator of the nutrients and the generator intends to manage the application of nutrients to the land.

Generator Information:	
Name of Generator of manure/prescribed materials to be land applied:	
Legal Name of the owner of the generating operation:	
Address	
Telephone:	
Operation Identifier (if previously assigned by Ministry):	
Land Owner/Receiver Information:	
Owner/manager of land on which manure/prescribed materials will be applied:	
Legal name of the owner of the receiving operation:	
Legal name of the land owner (if different from above):	
Address:	
Operation Identifier (if previously assigned by Ministry):	
Agreement Information:	
Term of Agreement (no less than one year):	
Agreement commences on:	
Agreement ceases on:	

This agreement, between the parties named above, allows for the following fields to be included in the farm unit operator's Farm Unit Declaration and for application of manure to these fields under the farm unit's nutrient management plan.

List each field/section under this agreement:

Field/ Section	**Lot**	**Concession**	**Township**	**County**	**Tillable Acres**	**Roll Number**

- There are more fields listed on the back of this form.

I, (landowner) give permission to _____(generator of manure/prescribed materials) to declare the above lands as part of the farm unit covered by the nutrient management strategy for the time period covered by this agreement. I also give permission to the farm unit operator/authorized agent to do soil sampling on the properties listed to determine the condition of the soil. I also agree that the land identified in this agreement will not be used for the application of any other prescribed material, originating from any other operation, including my own (if I have any) during the term of this agreement.

I also agree that the prescribed materials covered by this agreement will be applied in accordance to the nutrient management plan that applies to the farm unit into which these lands are incorporated.

A spill contingency plan was developed and fully reviewed by both parties.

Land Owner (print)	Signature	Date
Farm Unit Operator/Authorized Agent (print)	Signature	Date
Witness (print)	Signature	Date

Note: Permission to use these lands is required from all property owners listed on the title to the land. For properties owned by more than one person, permission may be given by additional owners in the form of a signature on this form or a signed letter accompanying this form.

NMA—REGULATIONS and PROTOCOLS	
SUBJECT OF LEGISLATIVE NOTE	**WHERE TO FIND MORE INFO**
Calculating Nutrient Units	Part 3 Nutrient Management Protocol
Maximum Liquid Manure Application Rates	Part VI in the Regulation
Setbacks from water courses	Part VI in the Regulation
Ban on use of High Trajectory Irrigation Guns	Part VI in the Regulation
Nutrient Management Plans	Part III and & in Nutrient Management Protocol
Phosphorus Index and Limit	Part IX and in NMAN

Do you know about Ontario's new Nutrient Management Act?

The provincial Nutrient Management Act (NMA) and the Regulation 267/03, as amended, regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the NMA call the Nutrient Management Information Line at 1-866-242-4460, e-mail nman@omafra.gov.on.ca or visit www.omafra.gov.on.ca.

Factsheets are continually being updated so please ensure that you have the most recent version.

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ISSN 1198-712X
Également disponible en français
(commande n° 05-026)

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